Enhanced Anaerobic Benzene/Hydrocarbon Biodegradation via Sulfate Amendment for Aquifer Remediation at a Refinery

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Laboratory and field evidence indicates that enhancing microbial sulfate reduction can be used to treat a large benzene plume (~0.5 square miles) in a sandy hydrocarbon impacted aquifer. Groundwater throughout the plume is depleted of electron acceptors including oxygen, nitrate, and sulfate. Groundwater in regions containing high concentrations of gasoline range hydrocarbons is saturated with methane, suggesting that hydrocarbon biodegradation occurs under methanogenic conditions. However, benzene biodegradation was not observed in incubations prepared with sediment and groundwater under methanogenic conditions. Upon the addition of sulfate however, benzene biodegradation was observed in samples collected from twenty locations throughout the site. The concentration of dissolved benzene fell to below 5 ug/L within five months in many of the samples that were supplemented with sulfate. Benzene biodegradation was also stimulated in the presence of free-phase hydrocarbon and relatively high concentrations of benzene (10 mg/L). Thus, hydrocarbon toxicity did not preclude benzene biodegradation.

Further, the high capacity for the sediments to precipitate sulfide (>30 umol HS^-/g sediment) limits the potential for dissolved sulfide accumulation. The field-scale remediation effort, consisting of injecting anaerobic water supplemented with sulfate and a conservative tracer (bromide) is underway. The cost to implement the technology is a fraction of the cost of more conventional approaches including air sparging and soil vapor extraction.